

1 Patent Application of Gary R. Fisher

2 for

3
4 TITLE: WATER WALL ASSEMBLY FOR GENERATING DYNAMICALLY
5 CHANGING WATER PATTERNS
6

7 CROSS-REFERENCE TO RELATED APPLICATIONS
8

9 This application claims priority of provisional application 60/422,542, which was
10 filed on October 31, 2002.
11

12 BACKGROUND OF THE INVENTION
13

14 This invention relates generally to water fountains and particularly to a
15 fountain for generating dynamically changing water patterns.

16 In the vast majority of prior art water fountains liquid is dispersed over the
17 outer surfaces of fountain elements or streamed via nozzles into the air both with
18 and against gravity. Rarely have water fountains been constructed where the
19 water feature is disposed behind a transparent or translucent surface. As an
20 example of this latter approach Chikazumi (US52888018) teaches a wall fountain
21 with transparent sheets arranged in a zigzag pattern. A series of valves feeding
22 nozzles are turned on and off by a controller to produce a variation of flows
23 constrained by the zigzag sheets. In another example Fuller and Robinson
24 (US4715136) teach a fountain comprised of a transparent plate disposed in

1 Patent Application of Gary R. Fisher for " Water Wall Assembly
2 For Generating Dynamically Changing Water Patterns" continued

3 Page 2

4
5 opposing relationship to streams of water impinging on the inner surface of the
6 plate; a number of computer controlled proportional valves feeding a number of
7 nozzles provide a kinetic display. Unfortunately, both of these inventions require
8 a complicated and expensive system of valves, nozzles, plumbing and controls to
9 generate a visually dynamic and interesting water display.

10
11 BRIEF SUMMARY OF THE INVENTION

12
13 It is a primary objective of this invention to provide a fountain wall
14 assembly wherein dynamically changing water patterns are disposed behind a
15 viewing surface without requiring valves and complicated plumbing.

16 It is a related object of this invention to provide a fountain wall assembly
17 with a translucent viewing sheet whose rear surface is formed with a multiplicity
18 of concave depressions for forming variable pathways for a flow of water.

19 It is a related object of this invention to provide a fountain wall assembly
20 wherein variations in dynamic water patterns are facilitated by variation of the
21 flow rate of liquid supplied to the wall assembly.

22 These and other objects of the invention are met by a water wall assembly
23 for generating decorative patterns on the rear of a translucent viewing surface,
24 comprising,

25 a translucent sheet with an essentially planar front surface and a rear
26 surface having a multiplicity of concave depressions;

27

Patent Application of Gary R. Fisher for " Water Wall Assembly
For Generating Dynamically Changing Water Patterns" continued

Page 3

a backing sheet disposed behind said translucent sheet with means defining a pathway for water to flow in the region between the two sheets from the top of said pathway to an opening in the bottom of said pathway; and supply means for generating a variable flow of liquid to said top of said pathway.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of a first embodiment of a water wall assembly according to this invention.

FIG. 2 is a side sectional cutaway view along line A-A in FIG. 1 showing the internal water channels of the first embodiment of the water wall assembly.

FIG. 3 is a sectional view taken along line B-B in FIG. 1.

FIG. 4 is a partial front elevation view of the pattern sheet of FIG. 1 taken facing the rear of the pattern sheet and illustrating several pixel-like depressions.

FIG. 5 is an enlarged sectional view of several pixel-like depressions taken along line C-C of FIG. 4.

Patent Application of Gary R. Fisher for " Water Wall Assembly
For Generating Dynamically Changing Water Patterns" continued

Page 4

FIG. 6 is an enlarged plan view of one of the pixel-like depressions in FIG. 5.

FIG. 7 is a front elevation view of a second embodiment of a water wall assembly according to this invention.

FIG. 8 is a side sectional cutaway view along line D-D in FIG. 7 showing the internal water channels of the second embodiment of the water wall assembly.

DETAILED DESCRIPTION

FIG. 1 shows a front elevation view of a first embodiment of water wall assembly according to this invention. FIG. 2 shows a side sectional view of the wall assembly taken along line A-A in FIG. 1. By reference to both figures, wall assembly 100 is comprised generally of base plate 124 with water inlet 125, front pattern sheet 110, middle reflecting sheet 142, rear sheet 140, pattern sheet retainers 120 and 122, top outlet cover 115 and top plate 130. Water from dynamic water supply means 190 enters the wall assembly at inlet 125, which is coupled to an opening in rear plate 140 via inlet housing 145. One example of dynamic water supply means 190 is a computer-controlled pump with time varying output flow rate.

FIG. 3 is a sectional view taken along the line B-B in FIG. 1 looking toward the top of wall assembly 100. By reference to FIG. 2 and FIG 3, rear sheet 140

4
5 and middle reflecting sheet 142 define a channel 160 for water to flow from water
6 inlet 125 to the top slot opening 135 in 142. The depth of this channel is defined
7 by the thickness of separator strips 155 and 156 in FIG. 3. For small tabletop
8 fountain displays the depth of channel 160 can be slightly less than the width of
9 pattern sheet 110. Pattern sheet 110 is a transparent or slightly translucent sheet
10 with a planar front surface 111 facing the viewer and a rear surface 112 defined
11 by a plurality of contiguous concave depressions. For different visual effects in
12 terms of the contrast between pattern sheet 110 and middle reflecting sheet 142
13 when water flows in channel 160, the percentage of light transmission of pattern
14 sheet 110 is preferably between 70% and 100%. Pattern sheet 110 can be cast,
15 extruded or injection molded in acrylic or styrene, or polyester resin as
16 appropriate. The degree of translucency of pattern sheet 110 can be controlled
17 by controlling the surface finish of the mold or die used in its manufacture.

18 Alternatively, while not shown in the figures, pattern sheet 110 can consist
19 of a transparent front glass plate with a cast plurality of contiguous concave
20 depressions bonded to its rear surface. In this case, the resulting "sandwich" is
21 rigid and will resist buckling when the width and height of the water wall are
22 large.

23 Middle reflecting sheet 142 is preferably opaque in this embodiment. By
24 reference to FIG. 1 and FIG. 2, pattern sheet 110 has a front planar side, which
25 faces the viewer and a rear patterned side comprised of a multiplicity of pixel-like
26 depressions. As shown in FIG. 3, the planar side of 110 is affixed to the
27 underside of the lips of pattern sheet retainers 120 and 122. The depth 172 of the

Patent Application of Gary R. Fisher for " Water Wall Assembly
For Generating Dynamically Changing Water Patterns" continued

Page 6

leg portions of retainers 120 and 122 is preferably slightly greater than the thickness 118 of pattern sheet 100 (see FIG. 5). The resulting channel 114 defined by the region between the front surface of middle reflecting sheet 142 and the rear surface 112 of 110 forms an internal pathway for water exiting top slot 135. This is preferable when the water wall is relatively small - for instance where the width and height of the water wall is less than approximately 16" by 24", respectively. Alternatively, for large water wall assemblies the depth 172 of the leg portions of retainers 120 and 122 is preferably equal to the thickness 118 of pattern sheet 110. In this case the rear or pattern sheet 110 will be in contact with the front surface of middle reflecting sheet 142. Liquid will then be constrained to the valleys in the multiplicity of depressions in pattern sheet 110. In fact to prevent pattern sheet 110 from buckling under water pressure, for example if it is cast in relatively thin acrylic or styrene, it is preferable to fixedly adhere the multiplicity of peaks 180 through 184 (see Fig. 5) to the front surface of middle reflecting sheet 142.

Pattern sheet 110 can better be understood by reference to FIG. 4 through FIG. 6.

FIG. 4 shows a partial front view of a portion of pattern sheet 110 with the pixel-like concave depressions uppermost. These depressions are preferably hemispherical and are oriented at 45-degrees to section line B-B in FIG. 1.

FIG. 5 shows an enlarged sectional view along line C-C of FIG. 4 illustrating several of the pixel-like depressions in cross section.

1 Patent Application of Gary R. Fisher for " Water Wall Assembly
2 For Generating Dynamically Changing Water Patterns" continued

3 Page 7

4
5 FIG. 6 is an enlarged plan view of one of these pixel-like depressions in
6 FIG. 5. As shown in FIG. 6 and by reference to FIG. 4, the borders of each
7 contiguous depression with its neighboring depressions form a multiplicity of
8 peaks 180, 181, 182, and 183. These peaks together with their corresponding
9 enclosed depressions form a multiplicity of contiguous "pixels". With sheet 110
10 as shown in FIG. 4, these "pixels" are analogous to the pixels on a computer
11 screen.

12 Now consider that a viewer is facing the front planar side of pattern sheet
13 110 and further consider an arbitrary pixel 185 in 110. If this pixel and the
14 intervening space between the pixel and the front surface of 142 are water filled,
15 the water will act as an index matching fluid; this will allow most of the light
16 incident on front surface 111 of 110 to be transmitted to the front surface of 142
17 thereby allowing the surface of 142 behind the pixel to show clearly through 110.
18 If on the other hand, there is no water behind the pixel and 142, then more light
19 will be locally scattered and reflected by it than if the region were water filled. The
20 maximum contrast between pixels that are water filled and pixels that are air filled
21 is attained if the front surface of 142 is black and pattern sheet 110 is slightly
22 translucent. Advantageously, the difference in the index of refraction of air and
23 water facilitates the development of a highly decorative dynamic water display.

24 The operation of wall assembly 100 shall now be discussed. Water from
25 supply means 190 is supplied to inlet 125, flows upward in channel 160, exits
26 through slot opening 135, falls in internal channel 114 and exits at opening 150 in
27 base plate 124. Water can also exit via gap 116 onto base plate 124. As an

1 Patent Application of Gary R. Fisher for " Water Wall Assembly
2 For Generating Dynamically Changing Water Patterns" continued

3 Page 8

4
5 alternative - not affecting the operation, described below, of the water wall - slot
6 150 can be sealed. Water will then solely flow over the surface of 124 via
7 opening 116 at the base of 110. A slot can then be provided at an arbitrary
8 location on 124 to facilitate drainage of the base plate or water can be allowed to
9 run over its sides for decorative effect. As another alternative, gap 116 can be
10 closed so that all water exiting the wall now flows through base plate 124 to
11 effect an essentially sealed fountain.

12 Consider that means 190 outputs water with fixed flow rate $f > 0$. After an
13 initial lag where water fills channel 160, water will begin to flow from slot 135 into
14 channel 114. As it does so, water will displace the air in each of the concave
15 depressions in 110 that it reaches. In fact for any *fixed* flow rate high enough to
16 allow water to flow from 135, a steady state pattern will develop in channel 114. If
17 f is high enough, water will eventually completely fill channel 114 and all of the
18 depressions ("pixels") in 110.

19 Now consider that the flow rate from means 190 is made to vary
20 dynamically over time within the range $0 \leq f < f_{\max}$ where f_{\max} is such that channel
21 114 is fully filled in steady state. Each change in flow rate great enough to allow
22 water to flow down 114 causes variation in the filling of channel 114. As this
23 occurs, dynamically changing patterns will evolve over pattern sheet 110. Since
24 water falling down channel 114 instantaneously takes the path of least
25 resistance, the sequence of water paths will be chaotic. The multiplicity of peaks
26 and valleys in the rear surface of 110 contributes to this chaotic effect. Further,
27 the 45-degree orientation of the peaks 180-184 (see Fig. 5) relative to section

1 Patent Application of Gary R. Fisher for " Water Wall Assembly
2 For Generating Dynamically Changing Water Patterns" continued

3 Page 9

4
5 line D-D in Figure 1 contributes to this chaotic effect by laterally diverting the
6 downward flow of water.

7 Advantageously, as supply means volume is varied and individual pixel-
8 like depressions are filled, air bubbles that formerly occupied these depressions
9 are displaced and propagate down channel 114 until they exit the wall. This
10 phenomenon generates a pleasing non-uniform "bubbling" sound while adding to
11 the visual effect of the invention.

12 FIG. 7 shows a front elevation view of a second embodiment of a water
13 wall assembly 200 according to this invention intended for large fountain
14 displays. FIG. 8 is a side sectional cutaway view along line D-D in FIG. 7
15 showing the internal water channels of this second embodiment. By reference to
16 FIG. 8, tube 310 communicates with an internal water reservoir which supplies a
17 distributed volume of water to the water wall. This water reservoir is defined by
18 reservoir base 320, rear sheet 300 and middle sheet 242. Water enters the wall
19 assembly via coupling 330 in direction 205 and flows via tube 310 to the
20 reservoir. Diverter plate 335 in the reservoir extends perpendicularly over the
21 outlet of tube 310 to facilitate uniform water distribution along the horizontal
22 extent of the reservoir. The top lip of middle sheet 242 acts as a spillway for
23 water to enter channel 214. For small water walls, the effective width of channel
24 214 is preferably substantially the same as that of channel 114 in the first
25 embodiment of the invention. For large water walls the rear of pattern sheet 210
26 is preferably butted against the front of middle reflecting sheet 242 as described
27

1 Patent Application of Gary R. Fisher for " Water Wall Assembly
2 For Generating Dynamically Changing Water Patterns" continued

3 Page 10

4
5 in the first embodiment. In this case, liquid will be constrained to the valleys in the
6 multiplicity of depressions in pattern sheet 210.

7 As in the first embodiment, gap 216 at the base of the water wall can be
8 sealed. Note that in Figure 8 the base of channel 214 is open, thus allowing liquid
9 to exit downward. By then providing a slotted opening at the base of a floor or
10 support structure on which the water wall is to be installed, the water wall can be
11 made to drain directly to a hidden reservoir not visible to those viewing the water
12 wall. This alternative draining method has no effect on the operation of the water
13 wall of embodiment two, said operation being identical to that of the first
14 embodiment.

15 Other embodiments and changes to the invention can be considered.
16 First, instead of the hemispherical depressions in pattern sheet 110 as shown in
17 the figures, other arrangements of contiguous or non-contiguous concave
18 depressions could alternatively be specified for pattern sheet 110. For instance a
19 pattern of diamond or cylindrical shaped depressions could be specified. These
20 would change the look of the display when in operation but would not change the
21 basic manner in which the display functions.

22 Second, although not shown in the figures for the first embodiment of the
23 invention, diverter strips can be variously disposed in channel 160 to modify the
24 distribution of flow across slot 135; this may be desirable when the ratio of the
25 height of pattern sheet 110 to its width is low.

26 Third, for water walls large in height and width, multiple supply tubes could
27 be disposed along the width of the rear of the wall assembly in the second

1 Patent Application of Gary R. Fisher for " Water Wall Assembly
2 For Generating Dynamically Changing Water Patterns" continued

3 Page 11

4
5 embodiment to reduce turbulence over that in the case of employing a single
6 tube (310) as shown in FIG. 8.

7 Fourth, a rear-illuminated embodiment of the invention can be considered.
8 As an example, middle reflecting sheet 142 (242) could be translucent and edge
9 lit. Alternatively, sheets 142 (242) and 140 (300) could be translucent with lighting
10 means suitably disposed to achieve the same effect.

11 Fifth, a multiplicity of water walls according to this invention can be
12 disposed in a pattern, each driven by separate supply means. Further, these
13 supply means can be synchronized to provide a coordinated display.

14 Sixth, a wall hanging water wall can be made wherein the operation is
15 identical to embodiments one and two, however having inlet and outlet means
16 that communicate with a reservoir containing pump means. This reservoir can be
17 a structure integral to the rear of the wall in Figures 7 and 8. Alternatively, the
18 reservoir can be disposed remotely from where the hanging water wall is to be
19 installed.

20 Although there has been shown and described hereinabove a specific
21 arrangement of a fountain assembly for generating decorative patterns in
22 accordance with the invention for the purpose of illustrating the manner in which
23 the invention may be used to advantage, it will be appreciated that the invention
24 is not limited thereto. Accordingly, any and all modifications, variations, or
25 equivalent arrangements, which may occur to those skilled in the art, should be
26 considered to be within the scope of the invention.